Wind Energy Forecasting: How to leverage the strengths of the private sector and the resources of the government labs & centers to accelerate renewable energies.

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President, Global Operations

January 21, 2009

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Overview

- About 3TIER
- How much wind energy did you say is coming?
- The basic science of wind energy forecasting.
- How the National labs & centers can help.

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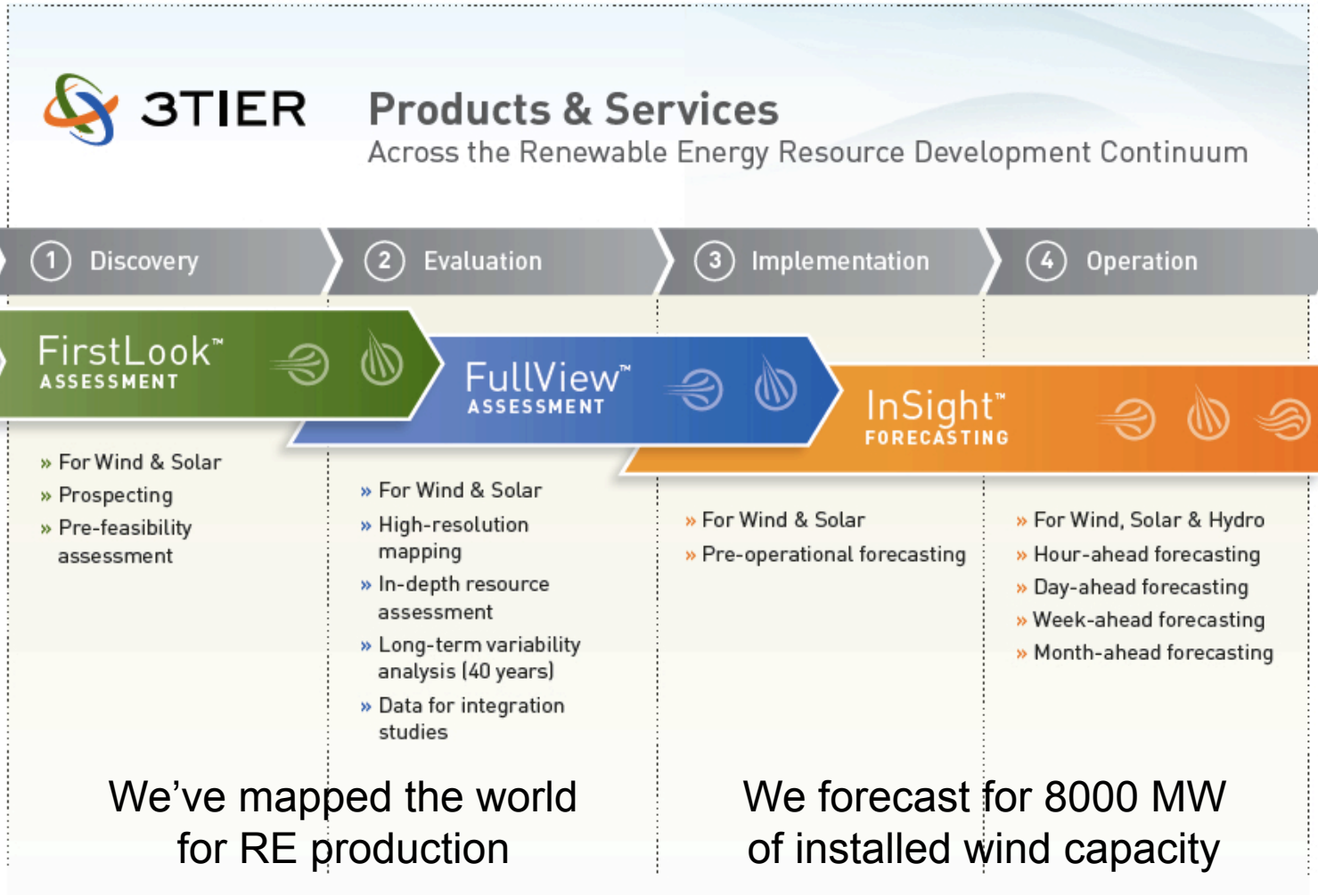
We are 80 people located in 5 offices worldwide



We've mapped the world for RE production

We forecast for 8000 MW of installed wind capacity

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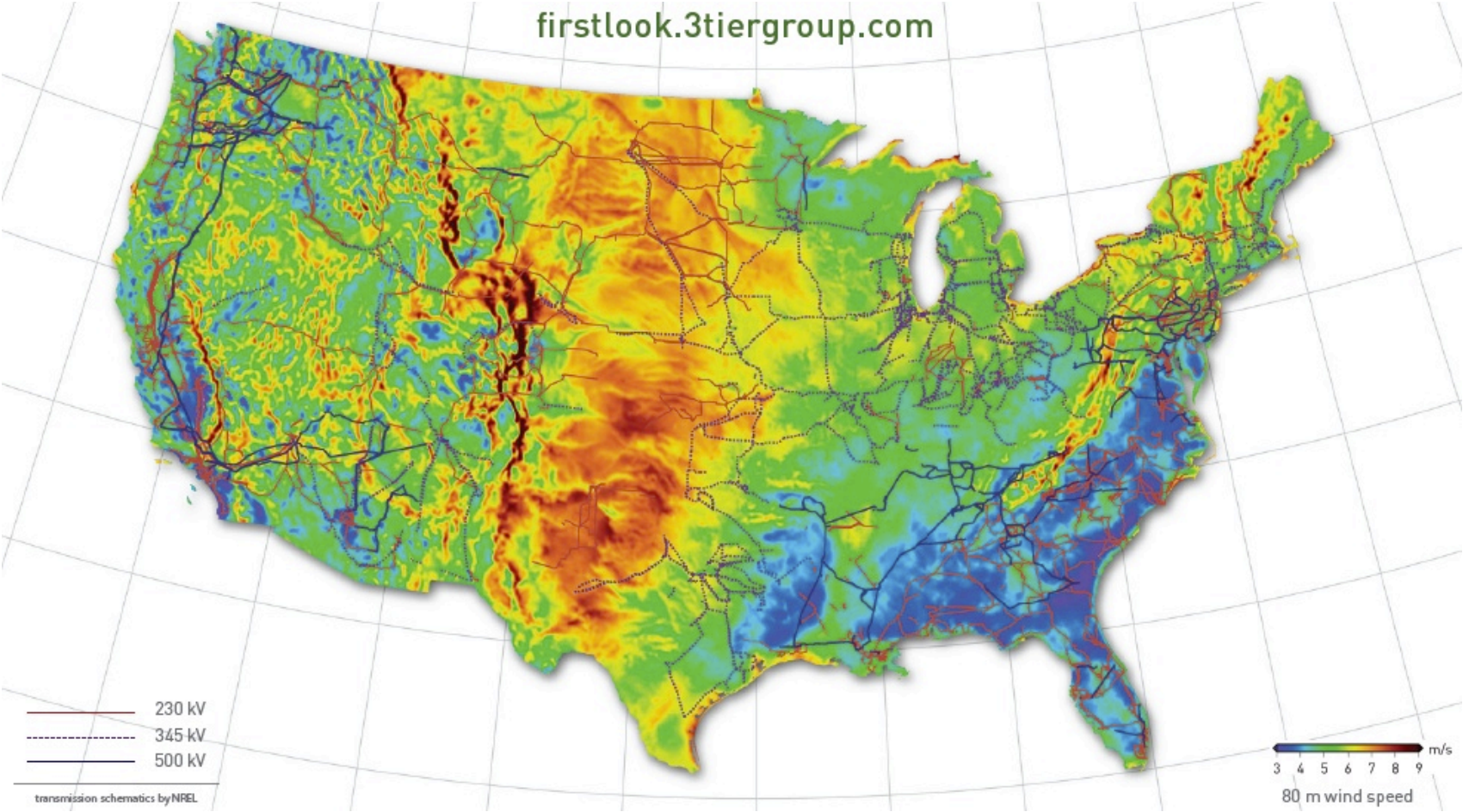
Wind Potential of the US

Reddish Shades are
7 meter/sec or greater.



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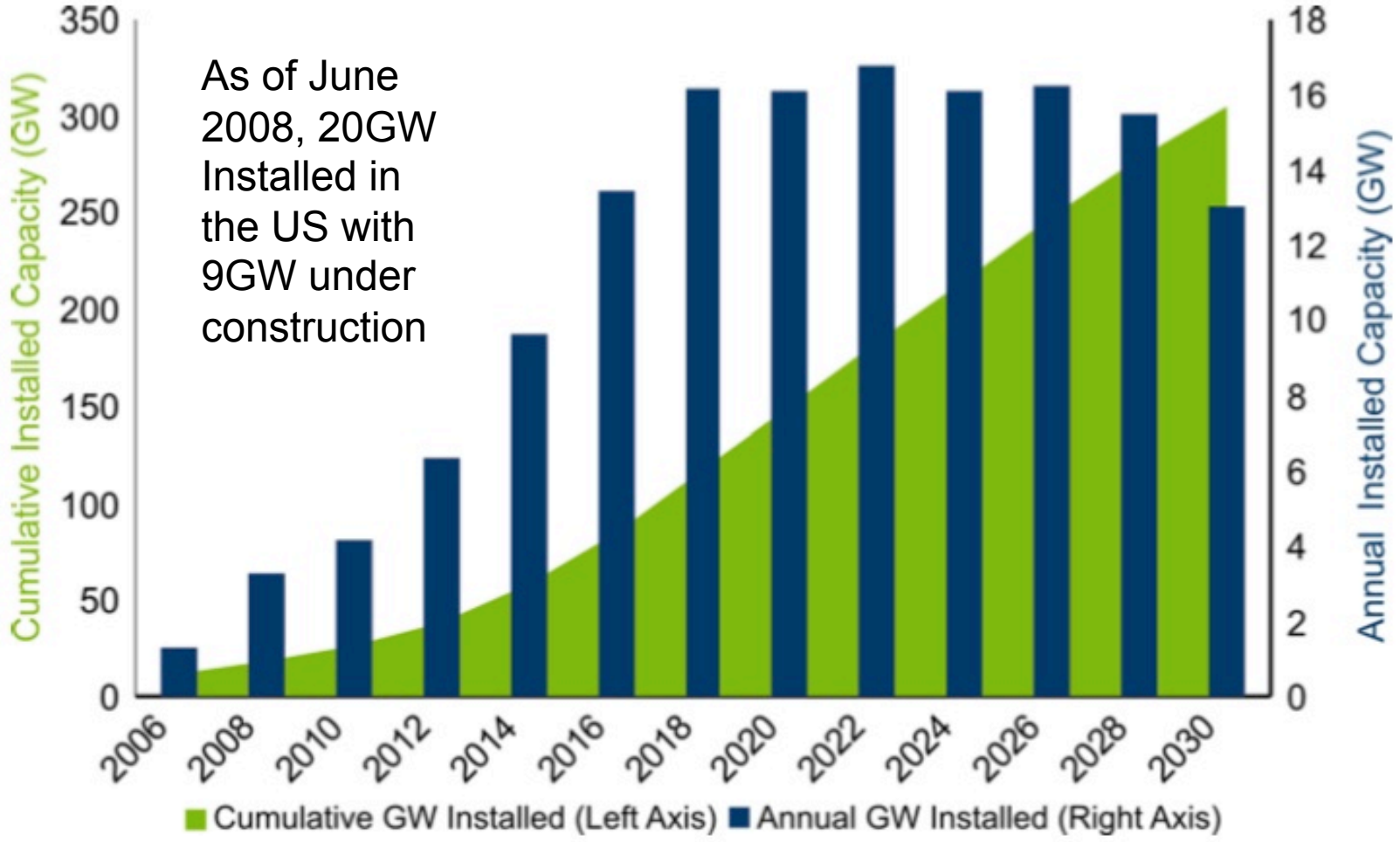
How much wind energy is coming?

Global warming & energy security are main drivers.

Figure 1-4. Annual and cumulative wind installations by 2030



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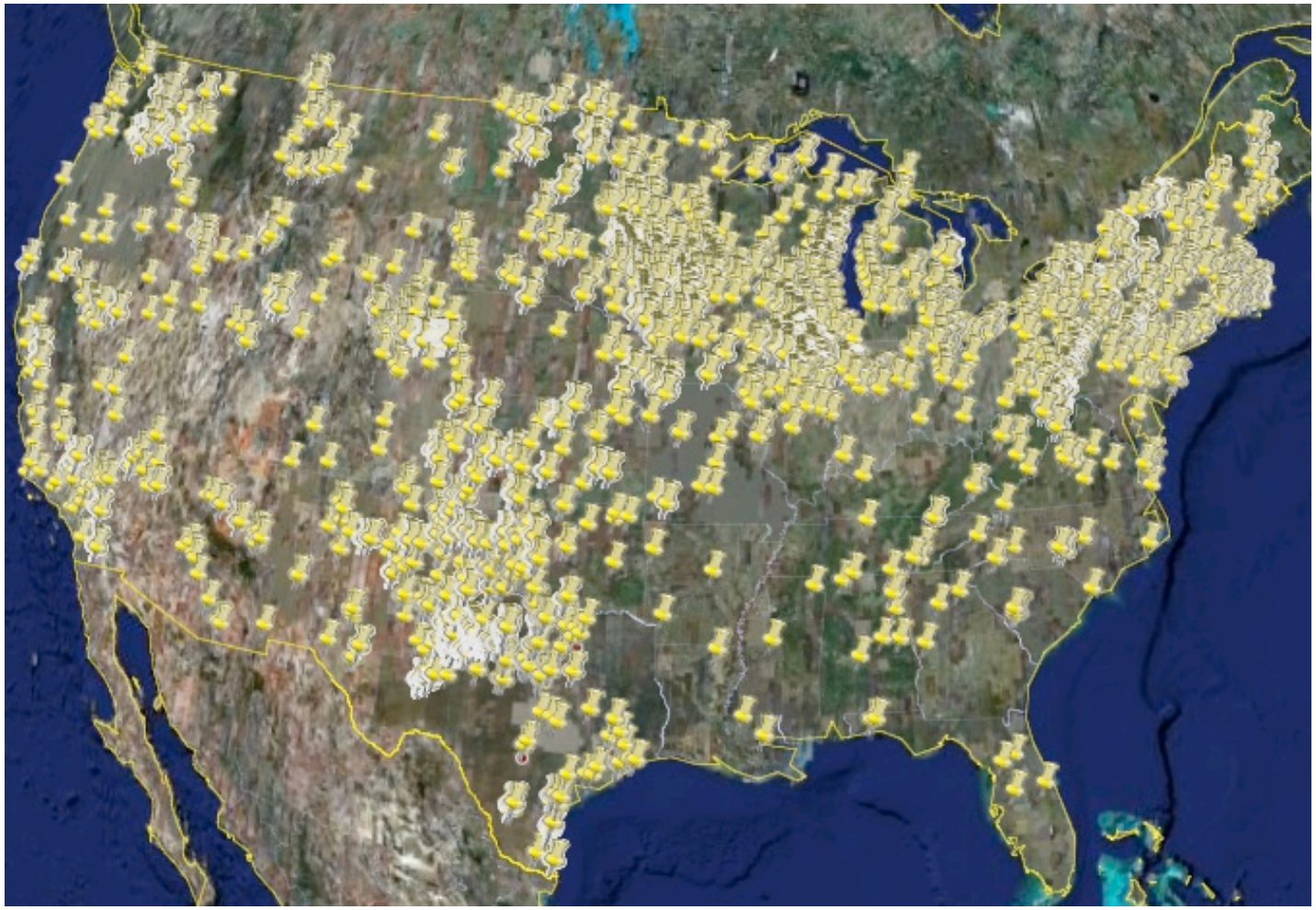
The developers are busy!
FAA permitted met towers above 50m tall



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Wind Forecasting: Just the Basics

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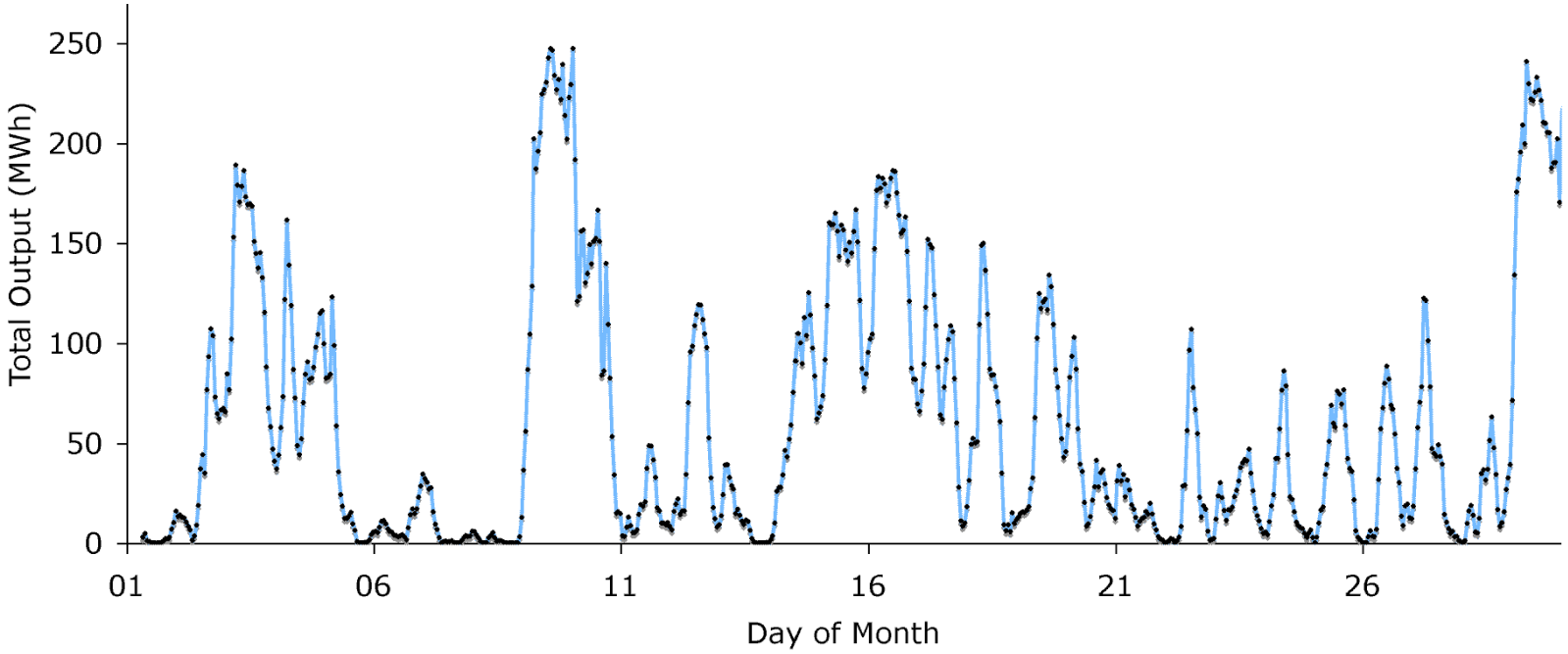
EXAMPLE HOURLY OUTPUT OF WIND ENERGY



This example:

- Highly Variable Output
- No output 10% of time
- Output <= 20% of capacity half the time

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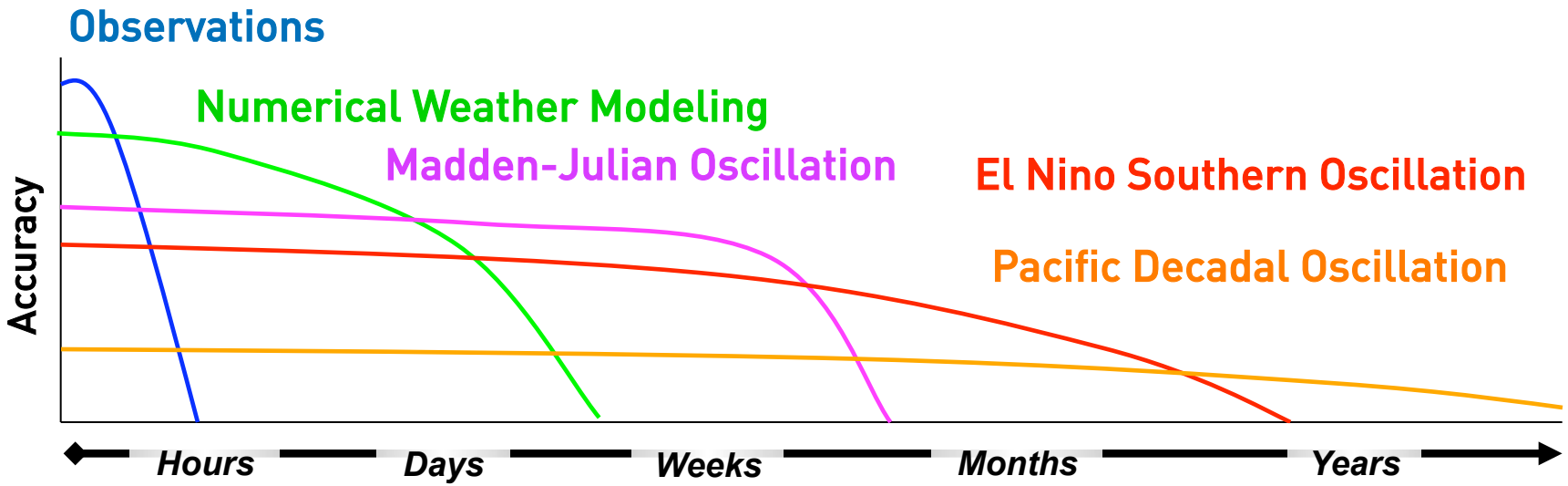
Forecast Horizons



- Spinning or firming reserves
- Load following
- Spot market

- Transmission scheduling
- Asset allocation
- Day ahead market

- Asset optimization
- Futures market
- Hedging

- Firm capacity
- Volumetric risk

Short-range | Medium-range | Long-range | Assessment

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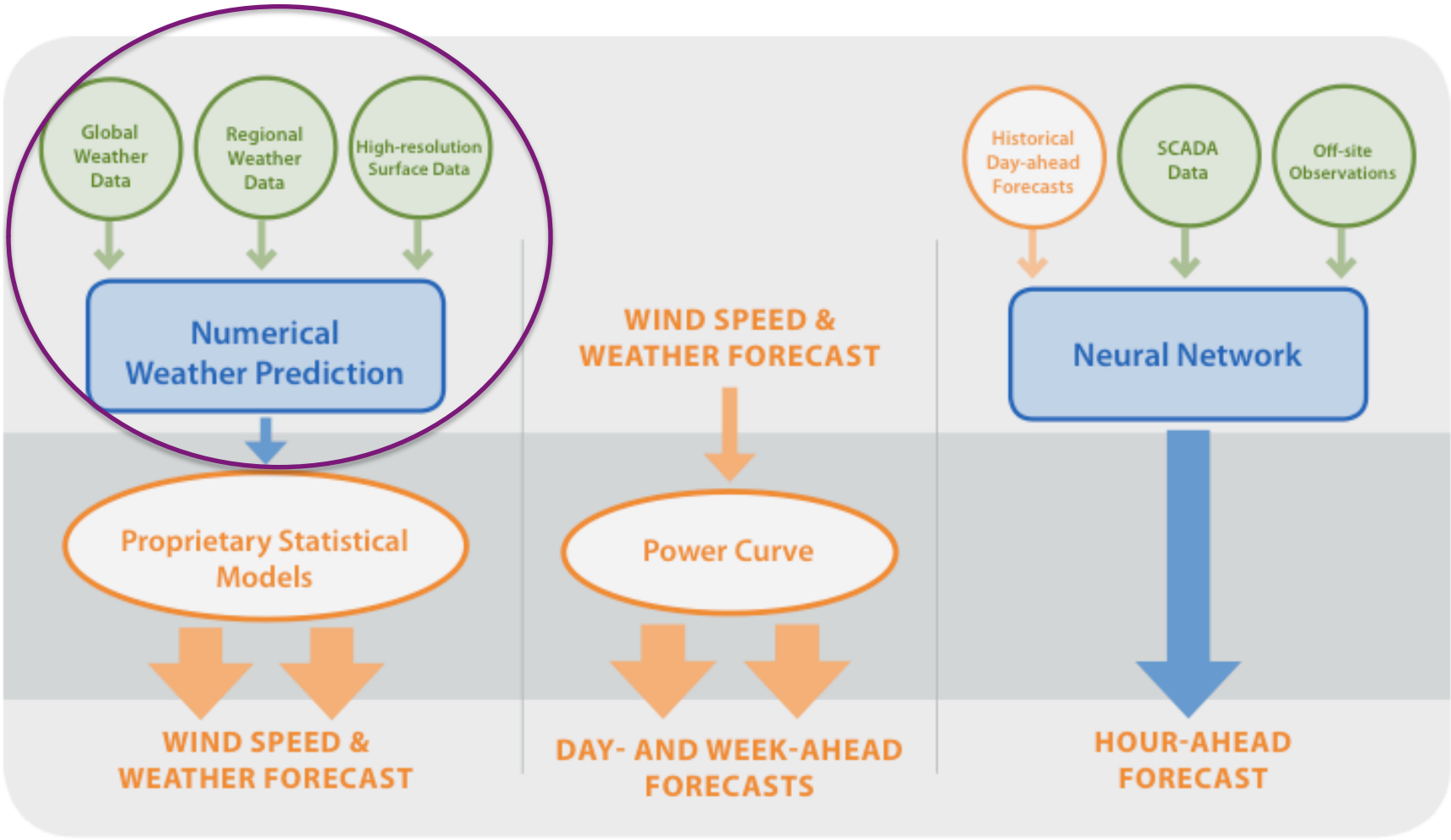
As a result, wind energy forecasting systems are necessarily complex



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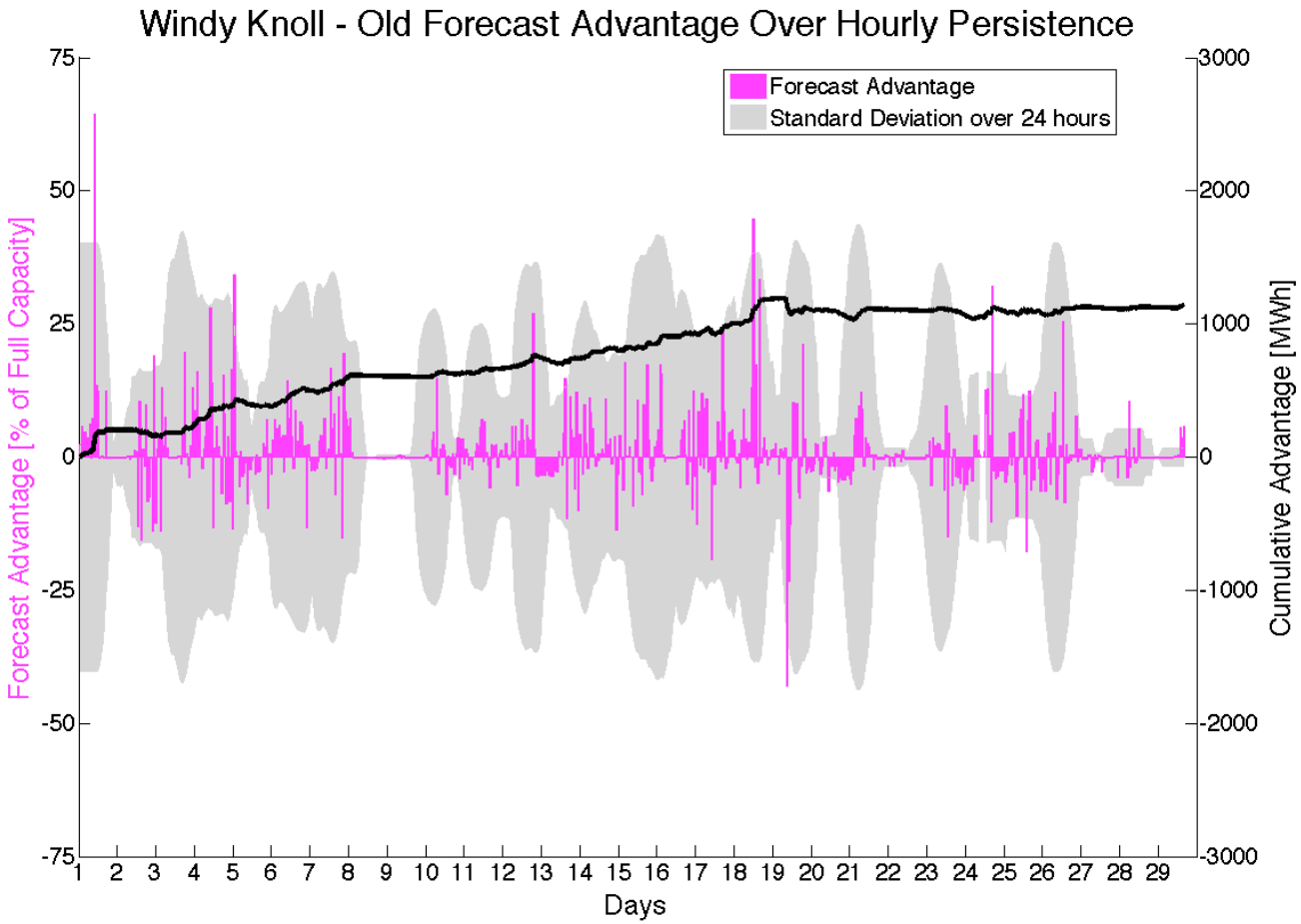
Forecasts beat persistence



3TIER beats persistence

Persistence beats 3TIER

The cumulative advantage is in 3TIER's favor

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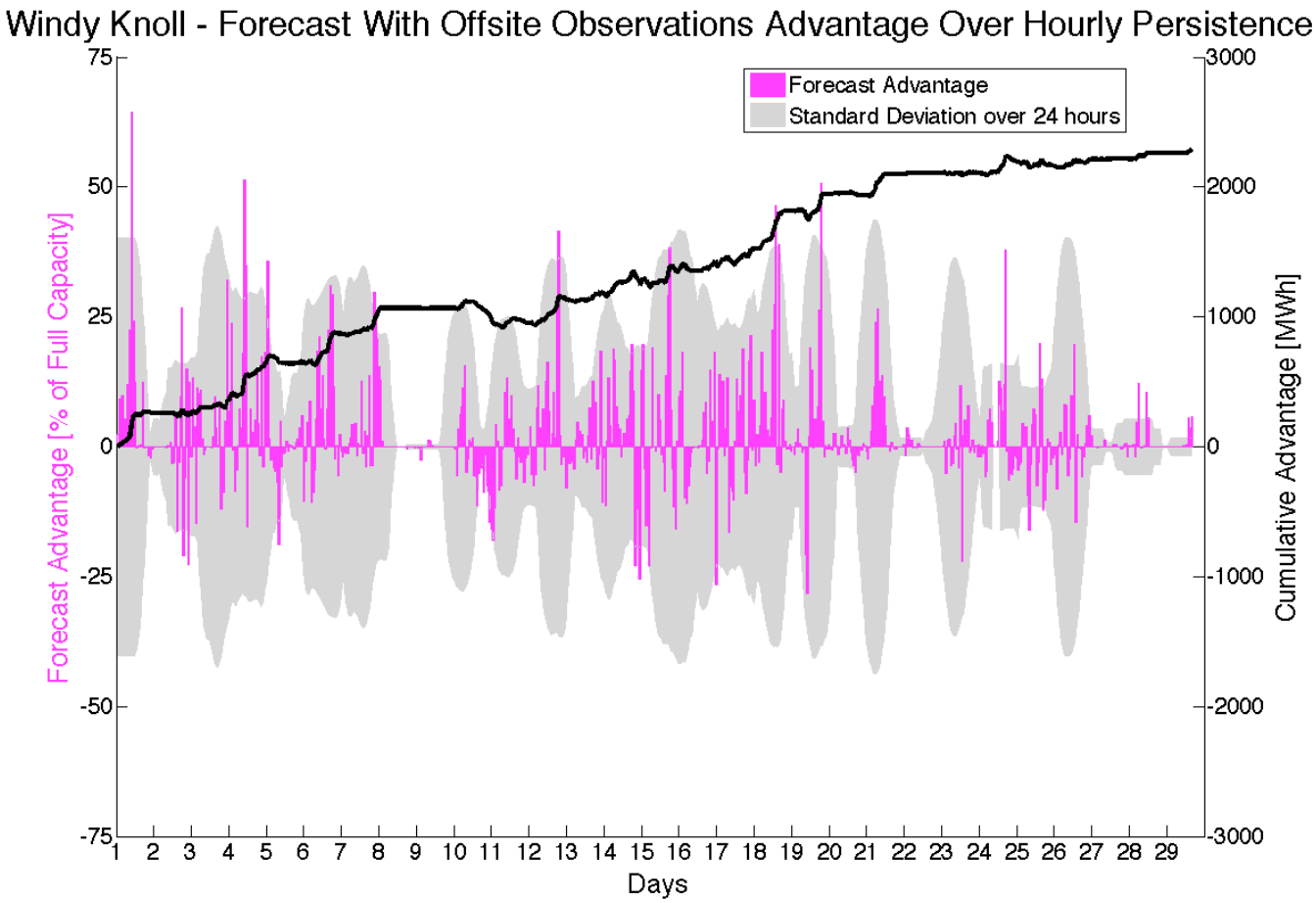
. . . And improves with additional data



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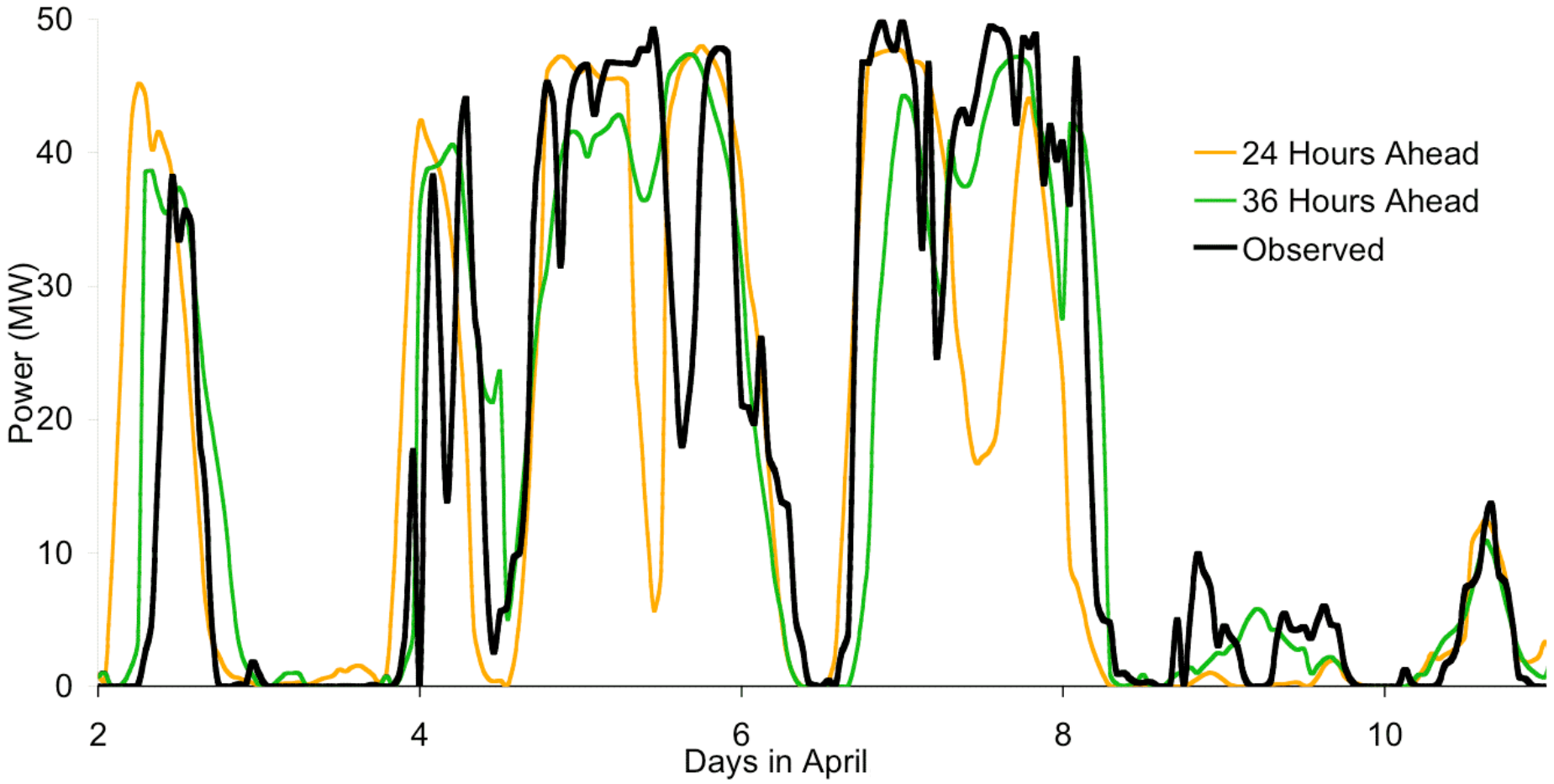
DAY AHEAD FORECASTS COMPARED TO OBSERVED PRODUCTION



DAY AHEAD FORECASTS ARE BASIS FOR RAMP PREDICTION

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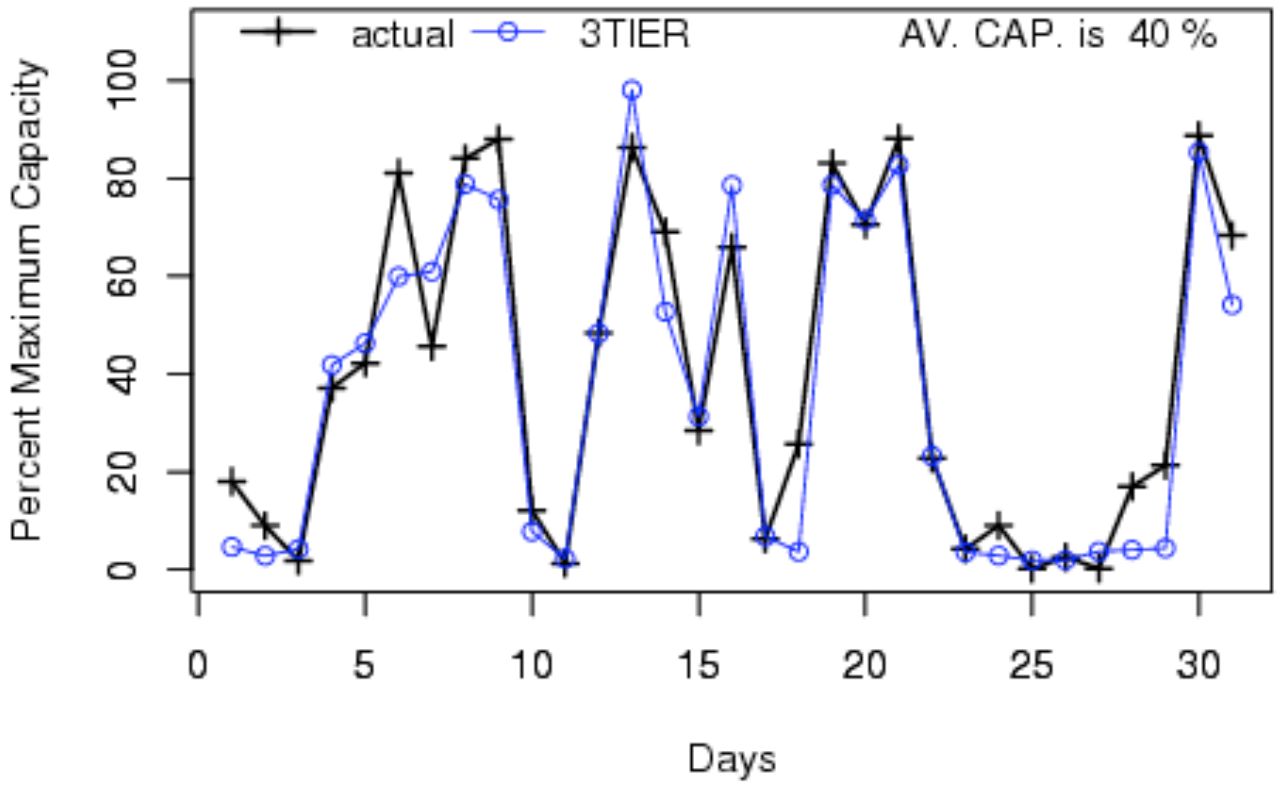
INTEGRATED DAY AHEAD FORECAST ACCURACY

Wind Park A 30 days ending 09/30/2006



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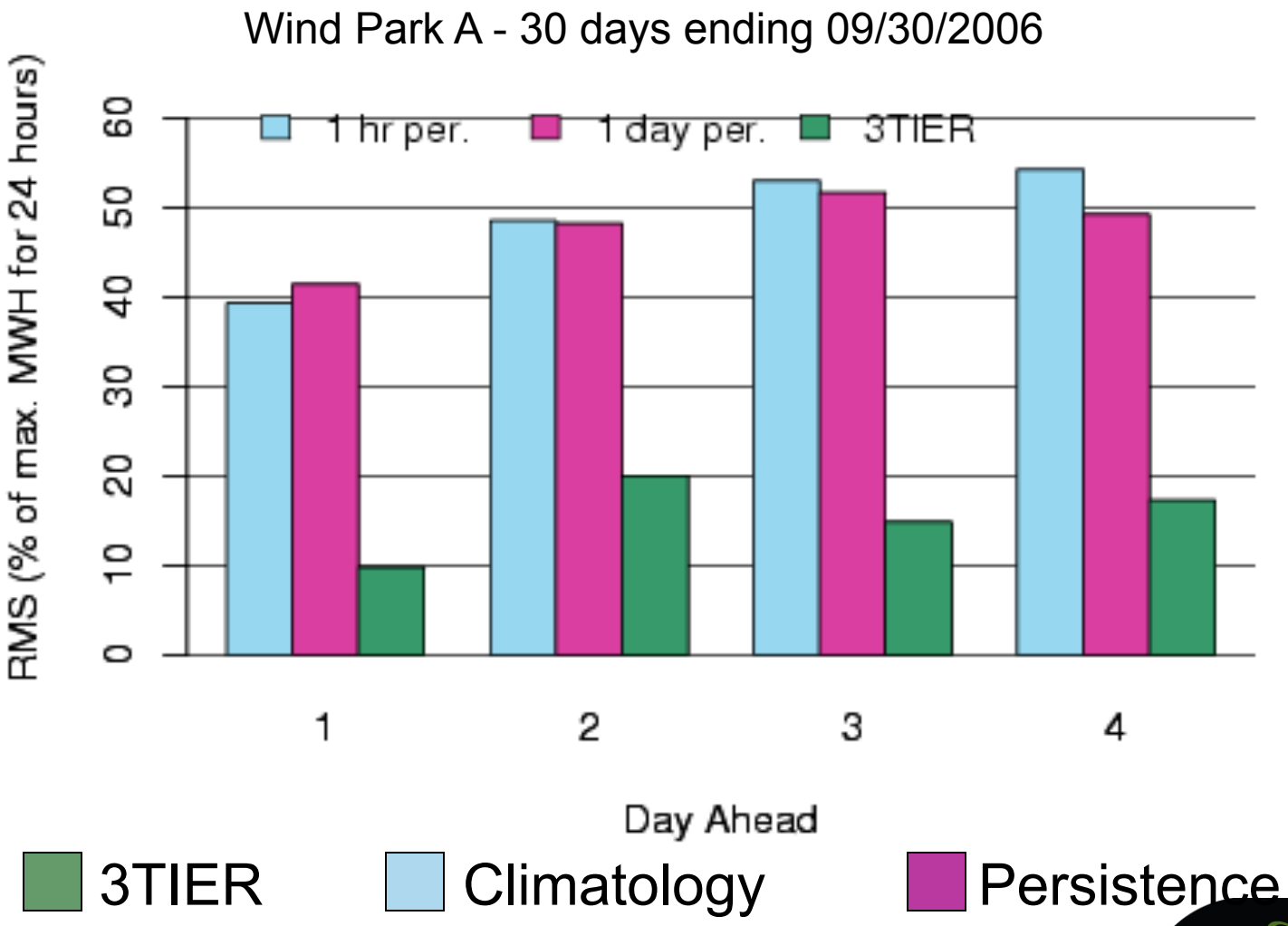
ONE TO FOUR DAY AHEAD FORECAST ACCURACY



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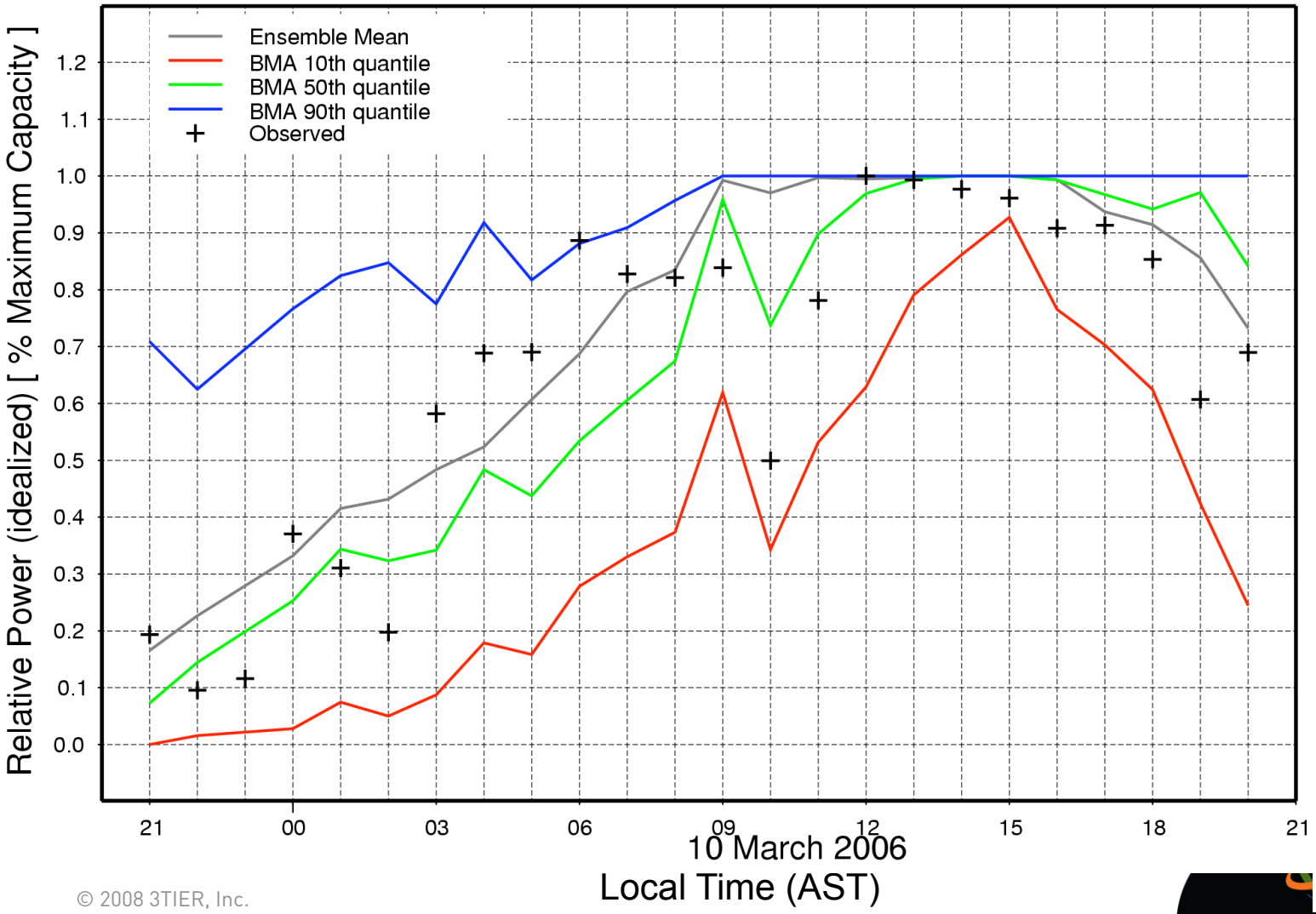
DAY AHEAD FORECAST (24-48 H)



+ Observed

80% Confidence Interval

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How can the national labs & centers help?

- Provide the private sector an environment rich in:
  - **Observed Data** for short term forecasting and forecasting verification and improvement
  - **High Quality Global and Regional Weather Forecasts** (both deterministic and ensembles)
  - Great Model Technologies (e.g. WRF) with improved parameterizations
  - Clear Technology Transfer Methods (for the data and technologies) so that the private sector (both end users and service providers) can continue to innovate and add value.

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How can the national labs & centers help?

- OBSERVED DATA
  - **RAMPS ARE REALLY HARD TO PREDICT WITHOUT GOOD OBSERVATIONS**
  - **Short Term Forecasts (a few minutes to a few hours) are critically dependant on observations, both at and around the wind farm**
    - **To feed into human and artificial neural networks.**
    - **To assimilate into rapidly updated NWP models**

    THERE ARE NUMEROUS EXAMPLES OF TECHNOLOGIES DEVELOPED ON IDEALIZED DATA THAT FAILED TO PERFORM AS ADVERTISED WHEN FACED WITH REALITY

EARTH OBSERVING SATELLITES TOO FOR NWP

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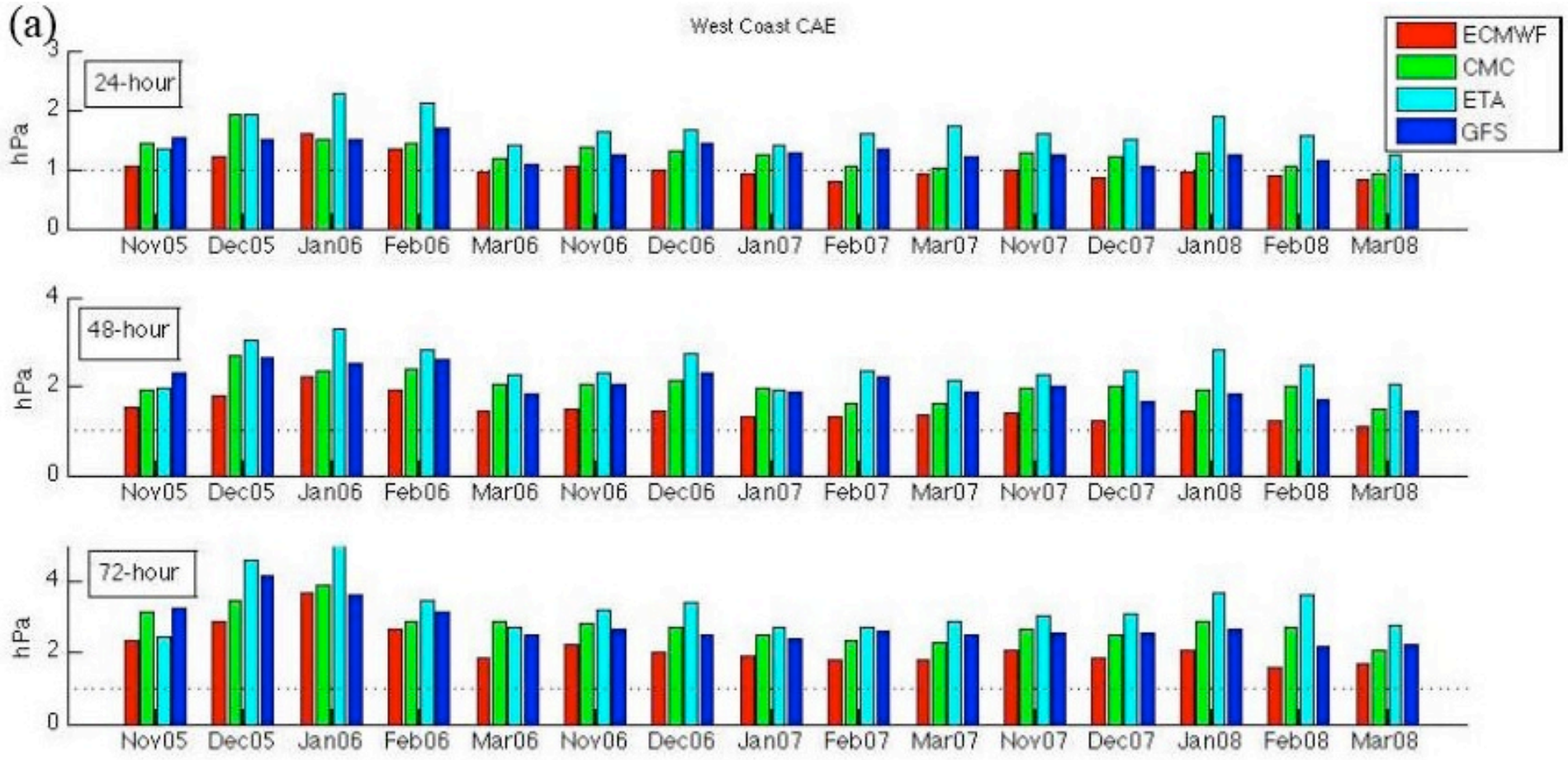
How can the national labs & centers help?

» BETTER NWP



Source: Wedam, McMurdie, and Mass. 2009, to be published WAF

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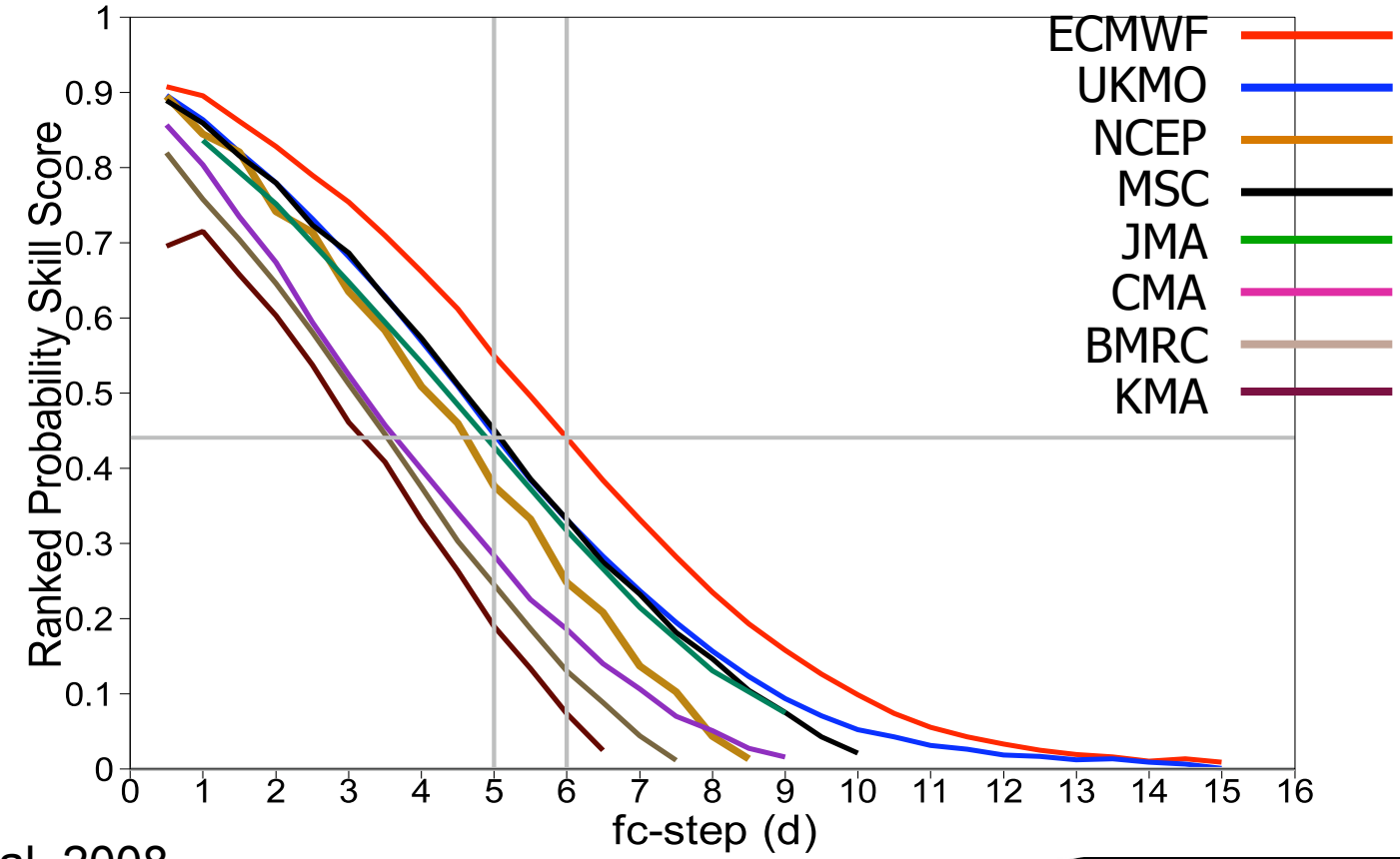
How can the national labs & centers help?

» BETTER PROBABILISTIC GUIDANCE



Source: Park et al. 2008

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How can the national labs & centers help?

"The next few days should be very interesting. Looks like a major lowland snow event is shaping up. Some of the details still need to be worked out in the models. Have been in discussion with other regional offices and at this point don't trust the GFS solution – and much prefer the EURO model. Will use the EURO model guidance to issue a winter storm watch".

Forecaster discussion in late December 2008 as Seattle was about to be "buried" under 12 inches of snowfall.

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How can the national labs & centers help?

"I can provide a number of other examples, but the basic conclusion is inescapable: the U.S. is seriously lagging in NWP even though we have the largest research community in the world. Just as important, we are not fulfilling our potential in this important enterprise – to provide the nation and world with the best possible forecasts."

"Unfortunately, (our) tremendous capability is too often unfocused, uncoordinated, and working in contradictory directions, with not-invented-here attitudes being widespread. Ironically our size gets in the way."

Professor Cliff Mass, January 19, 2008

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How can the national labs & centers help?

The installation of regional observation networks and the targeted improvement of NWP will aid not just renewable energy forecasting, but all commercial sectors impacted by the weather. This critically important effort can only be successfully completed by a coordinated effort led by our world-class government labs & centers.

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QUESTIONS?

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